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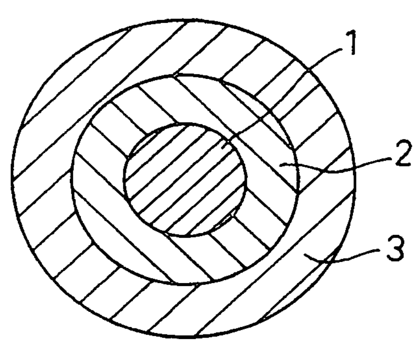
(54) Flame-retardant coated optical fiber.

(57) In a flame-retardant coated optical fiber, which comprises an optical fiber (1), a primary coating layer (2) covering the optical fiber (1), and a secondary coating layer (3) covering the primary coating layer (2), the primary coating layer (2) is made from an ultraviolet-curing resin, and the secondary coating layer (3) is made from a thermoplastic polyester elastomer containing 20 to 70 parts by weight of ethylene-bis-tetrabromophthalimide and 5 to 40 parts by weight of antimony trioxide based on 100 parts by weight of the thermoplastic polyester elastomer. The secondary coating layer (3) of the coated optical fiber has high flame retardancy and there is good bonding strength between the primary and secondary coating layers such that any projection of the optical fiber (1) from the end face of the coated fiber during actual use is too small to damage a light source attached thereto.

FIG. 1



EP 0 516 438 A1

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a flame-retardant coated optical fiber, and specifically, to a flame-retardant coated optical fiber in which a projection of an optical fiber from its end face during actual use is very small.

Prior Art

Recently, there has been an increasing demand for securing flame-retardancy of various office automation apparatuses. Accompanying this trend, positive flame retardancy has been increasingly required of coated optical fibers which are used for the wire arrangement of these apparatuses.

As shown in the sectional view of Fig. 1, a typical coated optical fiber comprises an optical fiber 1, a primary coating layer 2 covering the fiber 1, and a secondary coating layer 3 covering the layer 2.

In order to obtain a flame-retardant version of this coated optical fiber, according to a generally known arrangement, a self-extinguishing thermosetting silicone rubber is used as a material of the primary coating layer 2, for example.

By means of the coated optical fiber which primary coating layer consists of the thermosetting silicone rubber, however, it is hard to enhance its flame retardancy to a level standing the VW-1 test prescribed by UL1581.

Accordingly, a proposed flame-retardant coated optical fiber is such that the thermosetting silicone rubber is used for a primary coating layer. And this coating layer is covered with a secondary coating layer which consists of a plastic material blended with a brominated flame retardant such as decabromodiphenyl oxide or tetrabromophthalic anhydride. This coated optical fiber exhibits an appreciable flame retardancy, due to a synergistic effect produced by the self-extinguishing property of the thermosetting silicone rubber for the primary coating layer and the good flame retardancy of the brominated flame retardant in the secondary coating layer.

In the coated optical fiber covered by the primary coating layer consisting of the thermosetting silicone rubber, however, the adhesion of the secondary coating layer to the primary coating layer is insufficient. In some cases, therefore, the optical fiber, as a core of the coated optical fiber, may project from the end face of the coatd fiber if it is repeatedly subjected to temperature change, thereby damaging a light source which is connected directly to the optical fiber.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a flame-retardant coated optical fiber enjoying high flame retardancy.

Another object of the present invention is to provide a flame-retardant coated optical fiber in which a projection of an optical fiber from its end face during actual use is small enough to prevent damage to a light source connected directly to the fiber.

In order to achieve the above objects, according to the present invention, there is provided a flame-retardant coated optical fiber comprising: an optical fiber; a primary coating layer covering the optical fiber, the primary coating layer comprising an ultraviolet-curing resin; and a secondary coating layer covering the primary coating layer, the secondary coating layer comprising a material containing 20 to 70 parts by weight of ethylene-bis-tetrabromophthalimide and 5 to 40 parts by weight of antimony trioxide, based on 100 parts by weight of thermoplastic polyester elastomer.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is a sectional view of an optical fiber cable.

DETAILED DESCRIPTION

A primary coating layer of a flame-retardant coated optical fiber according to the present invention comprises an ultraviolet-curing resin.

Although ultraviolet-curing resins to be used are not particularly limited, available ultraviolet-curing resins include, for example, polyether-, polyester-, epoxy-, and polybutadiene-based urethane acrylates, or silicone acrylates.

These ultraviolet-curing resins are highly adherent to a secondary coating layer (mentioned later), so that the bonding strength between the primary and secondary coating layers is enhanced.

Thus, the ultraviolet-curing resins serve to reduce a length of projection of the optical fiber which projects from the end face of the coated fiber during actual use of the coated fiber.

The secondary coating layer is a resin composition which comprises thermoplastic polyester elastomer as a base material, blended with ethylenebis-tetrabromophthalimide, as a brominated flame retardant, and antimony trioxide, as a flame-retardant assistant.

The secondary coating layer containing ethylenebis-tetrabromophthalimide as the flame retardant has an exellent adhesion to the primary coating layer, as compared with those using other brominated flame retardants, and can minimize the projection of the optical fiber mentioned above.

The loading of ethylene-bis-tetrabromophthalimide is adjusted to 20 to 70 parts by weight based on 100 parts by weight of thermoplastic polyester elastomer. If the loading is lower than 20 parts by weight, the flame retardancy of the resulting resin composition is insufficient. If the loading is higher than 70 parts by weight, on the other hand, the adhesion to the primary coating layer is insufficient, so that an amount of the projection of the optical fiber during actual use becomes intolerable. Preferably, the loading ought to range from 30 to 60 parts by weight based on 100 parts by weight of thermoplastic polyester elastomer, and on an optimal base, from 30 to 40 parts by weight.

Antimony trioxide is a flame-retardant assistant which serves, in combination with ethylene-bis-tetrabromophthalimide , to improve the flame retardancy, and its loading is adjusted to 5 to 40 parts by weight based on 100 parts by weight of thermoplastic polyester elastomer. If the loading is lower than 5 parts by weight, this material cannot provide any flame-retardant effect. If the loading exceeds 40 parts by weight, on the other hand, the projection of the optical fiber during the actual use of the coated fiber lengthens. Preferably, the loading ranges from 7 to 30 parts by weight based on 100 parts by weight of thermoplastic polyester elastomer, and on an optimal base, from 10 to 25 parts by weight.

The flame retardant-coated optical fiber according to the present invention is produced by, for example, coating an optical fiber with the aforementioned primary coating layer, then irradiating the resulting structure with ultraviolet rays to treat the primary coating layer, and further extrusion-coating the primary coating layer with the aforementioned secondary coating layer. The dose of ultraviolet rays applied to the primary coating layer preferably ranges from about 100 to 1000 mJ/cm^2, and the extrusion temperature preferably ranges from about 210 to 240°C.

Examples 1 to 4 & Controls 1 to 7

Optical fibers each having a diameter of 0.125 mm were coated respectively with primary coating layers (0.14 mm thick) shown in Table 1. For Examples 1 to 4 and Controls 1 to 5, the primary coating layer was formed by first applying an ultraviolet-curing resin (including photopolymerization initiator) to each optical fiber and then irradiating the resulting structure with 300 mJ/cm^2 of ultraviolet rays. For Controls 6 to 8, the primary coating layer was formed by applying a silicone resin to each optical fiber and curing the resin by heating.

The flame retardancy and optical fiber projections of the individual coated optical fibers thus obtained were examined according to the following specifications. The measurement results are shown in Table 1 below.

Flame retardancy: The VW-1 test was conducted according to the method prescribed by UL1581. Circles and crosses represent "acceptable" and "unacceptable", respectively.

Projection: Each coated optical fiber was cut to a length of 1.5 m, the cut piece was subjected to 100 cycles of a heat cycle test in a range from -40 to 80°C, and the projection was measured in profile by using a universal projector. Circles represent those specimens with optical fiber projections less than 0.5 mm, while crosses represent those specimens with fiber projections longer than 0.5 mm.

Table 1

		Example No.				Control No.							
		1	2	3	4	1	2	3	4	5	6	7	8
Material of primary coating layer		Ultraviolet-curing resin *3				Ultraviolet-curing resin *3					Silicone resin		
Composition of secondary coating layer (parts by weight)	HYTREL HTC2551*1	100	100	100	100	100	100	100	100	100	100	100	100
	SAYTEX BT93*2	30	60	30	60	15	90	90	60	–	15	60	0
	Tetrabromophtalic anhydride	–	–	–	–	–	–	–	–	30	–	–	–
	Sb_2O_3	7	7	30	30	7	30	3	50	7	7	30	0
Flame retardancy		○	○	○	○	×	○	×	○	○	○	○	×
Projection		○	○	○	○	○	×	×	×	×	×	×	×

*1: Trademark; thermoplastic polyester elastomer from Toray-Dupont Industries, Inc.

*2: Trademark; ethylene-bis-tetrabromophthalimide from SAYTEX Co., Ltd.

*3: Polyester-based urethane acrylate ultraviolet-curing resin

*4: Thermosetting resin

Claims

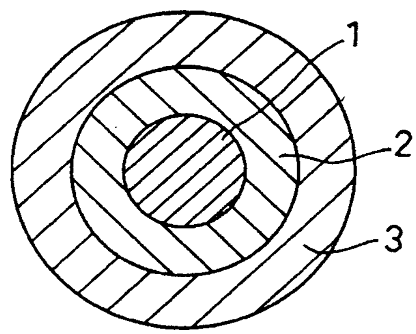
1. A flame-retardant coated optical fiber comprising:
   an optical fiber (1);
   a primary coating layer (2) covering the optical fiber, said primary coating layer comprising an ultraviolet-curing resin; and
   a secondary coating layer (3) covering the primary coating layer, said secondary coating layer comprising a thermoplastic polyester elastomer containing 20 to 70 parts by weight of ethylene-bis-tetrabromophthalimide and 5 to 40 parts by weight of antimony trioxide, based on 100 parts by weight of said thermoplastic polyester elastomer.

2. A flame-retardant coated optical fiber according to claim 1, wherein said primary coating layer is a polymerised ultraviolet-curing resin selected from urethane acrylate compounds and silicone acrylate compounds.

3. A process for the preparation of a flame-retardant coated optical fiber as defined in claim 1 which comprises coating an optical fiber with an ultraviolet-curing resin, irradiating the resulting coated fiber with ultraviolet rays, and extrusion-coating the primary coated fiber so obtained with a thermoplastic polyester elastomer containing 20 to 70 parts by weight of ethylene-bis-tetrabromophthalimide and 5 to 40 parts by weight of antimony trioxide based on 100 parts by weight of said thermoplastic polyester elastomer.

4. Use of flame-retardant coated optical fibers as defined in claim 1 in electronic automation apparatus having enhanced fire resistance.

FIG. 1



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 30 4872

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	EP-A-0 295 336 (E.I DU PONT DE NEMOURS AND COMP) * page 7, column 40 - page 8, column 4 * * claims 1-24 *	1-4	C03C25/02 G02B6/44
Y	WORLD PATENTS INDEX LATEST Week 8609, Derwent Publications Ltd., London, GB; AN 86-058680 & JP-A-61 010 044 (SUMITOMO ELEC IND KK) 17 January 1986 * abstract *	1-4	
Y	WORLD PATENTS INDEX LATEST Week 8628, Derwent Publications Ltd., London, GB; AN 86-178219 & JP-A-61 091 610 (SHOWO ELEC WIRE KK) 9 May 1986 * abstract *	1-4	
A	EP-A-0 210 770 (STC PLC) * claims; figure 1 *	1-4	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	EP-A-0 365 129 (E.I DU PONT DE NEMOURS AND COMP) * claims 1-2,4,6,8,12-14 *	1	C03C C08K C08L G02B B32B
A	EP-A-0 146 104 (MOBAY CORP) * claims 1-5 *	1	
A	EP-A-0 132 228 (CIBA-GEIGY AG) * claims 1-6 *	1	
A	EP-A-0 083 796 (BAYER AG) * claim 1; table *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	17 SEPTEMBER 1992	KUEHNE H.C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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